

Comments from the questionnaire:

Question 3: Which guidelines would you accept within risk assessments of sites contaminated with PAHs? (Please choose as many as relevant)

I have answered above, subject to the prevailing situation whereby all the guidance, SGVs, TOX data, etc. in the process of revision and reissue. The boxes ticked denote the methodologies I felt happy with prior to withdrawal of the guidance, etc.

Any values are acceptable as long as the derivation of the values is transparent and in line with current UK risk assessment methodology.

We have to use some sort of guidelines ... as long as the risk assessment was scientifically robust we would be prepared to review it and use our professional judgement.

Obviously with the release for trial of the new CLEA system and withdrawal of the SGVs, this has changed the assessment criteria we would use.

I also accept ssac's generated using risk 4 in all cases all data used to generate this data must be submitted in order that it is peer review able evidence of changes to the models to comply with uk guidance is also required

Site specific risk assessment is accepted as long as the process of deriving the assessment criteria is provided and complies to UK current best practice.

Acceptance would be dependant upon level of contamination and likely significance

RISC

ASTM-RBCA has also been used and accepted. The very large corrections that are applied within all models to account for the various toxicological uncertainties together with the [usually] exaggerated exposure durations means that most of the debate about most appropriate model is a little redundant, in particular when the site is being considered under planning (the typical scenario), not Part IIA.

Regarding RBCA and ATRISK, the values would only be acceptable

as long as the values generated are fully justifiable and are accompanied by supporting spreadsheets etc

All model derived assessment values would need to prove compliance with current policy and statutory guidance

Of those indicated above, their suitability to the site in question would be established on receipt of the report.

There is no clear guidance at present on what values to use. LAs are at present basically in a position where we been asked to calculate values for each site with little guidance from DEFRA. This lack of guidance also has implications for our PPS23 work.

RISC

No sites have been determined/investigated for PAH contamination in the district under the EPA 1990. When reviewing sites through the planning regime, as long as justification is provided as to the use of the criteria and it is in accordance with current guidance it may be accepted. For instance risk assessments from other countries (i.e RBCA) if possible should be modified so it is in accordance with current guidance for England.

My only comment here is that there were very few SGVs before which made the work challenging. Now that these have been withdrawn it is even more difficult

Used as a reference in the absence of other guideline values. Sites are generally regarded as potentially contaminated until intrusive investigations prove actual risk.

We would accept other risk assessment methods if they have used best practice and have closely followed UK Guidance

We would consider the use of any GAC that are appropriate for the use at the site considered. Many consultants use the same methodology for deriving such criteria hence my selection of ATKINS, LQM and other consultants.

None

Most models are acceptable as long as they are tailored to fit standard UK exposure scenarios

I will accept site specific assessments, as long as input values and risk tool is justified

Would accept SSACs derived using commercially available models e.g. RISC etc provided that the scenarios were appropriate for the site in question

Other screening criteria derived from transparent methodologies may be acceptable, as long as it is clear to me as CLO how they have been modified for UK regime-compliant uses. "Black-box" derivation of threshold values where the source data or workings and not clear/reproducible is not preferred.

Site specific assessment values would be dependant upon the assumptions within the model used being justified and acceptable.

If the values are well referenced we could accept any.

I will accept any SSAC or GAc that have been derived in accordance with CLEA criteria, this includes models from other countries that have been adapted to CLEA specifications. I will not accept ICRL, other, similarly out-of-date values or those not derived in accordance with CLEA.

Have not accepted the use of assessment criteria for use in other countries i.e DIVs and Region 9 PRGs values as they have only presented as GACs. Would possibly consider these values as SSACs if they could be demonstrated to be protective of the site in terms of its exposure scenario.

May accept site specific assessments submitted by consultants providing they are able to justify their use

This will depend on whether this is an initial screening assessment or a more detailed assessment. Also, whether the site is being developed through planning or formal action taken through Part IIA

Lack of experience in the field of contaminated land - relevant guidelines not necessarily known

Sorry but it is unclear in what context you are asking this question, is it a human health RA or for controlled waters. Additionally you only accept some of the risk assessments provided they have been amended to be UK compliant.

Site specific criteria will be accepted where derived from robust, justifiable and relevant risk assessment models which have been adapted to be in line with UK policy.

DWS and EQS would only be accepted under certain circumstances. Values derived from other models may be accepted provided justification is given.

Wasn't clear whether you meant for determining sites under Part 2A or through Planning. Generally for planning would accept reasonably derived SSAC making any necessary amendments for UK situation as necessary. For Part2A would accept a similar level of information as for Planning at a screening level, but would require a much more detailed risk assessment (again tailored to the UK situation) for any determination. Certain determinants (e.g. BaP) produce very conservative criteria (as acknowledged by DEFRA and Agency in way forward) - I would currently avoid determining a site based some of the typical outputs of models. Hopefully we will be in a better position once the outputs of the Way Forward are published at the end of August.

I prefer that risk assessment is carried out on a site specific basis with generic values used only for screening purposes

Only accept non CLEA or CIEH guidance on site specific basis if justified by supporting evidence that is suitable in each individual case.

We would accept site specific risk assessment criteria from other risk assessment models that are not CLEA only if the input parameter were compliant with UK policy.

There is no soil guideline value for PAHs/BaP in the UK. We have a TOX report from which the derived SGV is around 1mg/kg for BaP, this is pretty much the same as the CIEH/LQM GAC. These values are usually well below the background concentrations in urban areas such as (*name of the Local Authority*). This makes the value fairly meaningless. The GAC is a considered to be the highest 'safe' value, what we do not have is knowledge of what value might cause 'harm' of 'significant possibility of harm'. Also lacking is data on land uses other than residential gardens and allotments e.g. public open space.

The risk assessor would have to demonstrate that the SSAC had been derived in a manner consistent with UK policy. Similarly for GAC and additionally the conceptual exposure scenarios would have to appropriate for the site concerned.

I have accepted Site Specific Assessment Criteria for PAH based no Toxicity Equivalent factors as this seems a logical approach. I would also accept generic values derived by large consultancies such as Hydrock, Hyder, Atkins, WSP etc so long as the figures were derived using accepted models (e.g. CLEA, SNIFFER), and do not differ too greatly from those derived by LQM GAC or other transparent approaches. Consultancies seem to favour SNIFFER, though RBCA is increasingly popular for

commercial sites (screening values derived using RBCA seem to be rather generous!)

If i was determining a site under part IIA i would only use site specific criteria derived using the most appropriate model or combination of algorithms based on the conceptual model of the site, taking into account relevant authoritative and scientific guidance. I can't say which model would be appropriate, neither can i comment on the health criteria values that would applied although i would no doubt consider as many different approaches and i would probably assess the site under a number of different approaches and models to see how this affected outcome of the assessment.

(Name including the location) have published guidance for developers, standardising the values that we would find acceptable - SGVs where available, GACs next (as they were derived using CLEA methodology). This is aimed at assuring consistency within the county. Where SGVs/GACs are not available, other derived figures are acceptable, but adjustments for UK policy must be made/justified.

Need to check the suitability of the models (in particular SNIFFER) to the site in question. Dermal pathway not covered by SNIFFER. Need to also check the assumptions behind the ATKINS values to see if it matches the activities on the site. Obviously none of these models can provide an indication of SPOSH and are usually set to produce values representing minimal risk. This is not really any use for Part 2A unless the contamination levels fall below these values.

providing were compliant with UK guidance and context

I would accept the screening level that was most appropriate for the site, and for determination it would be site specific based on the known characteristics of the site, however that be derived.

Question 4: How often has bioremediation been used to clean-up PAH-contaminated land in your area?

I would always encourage the preservation of soil resources on site whenever possible.

We would consider each site separately.

my only experience of bioremediation is a site which went through planning and we basically it didnt work!! as a result i am now very obsessed with validation - i would expect the consultant to prove it had worked for more than one cycle.

I understand that bioremediation is very expensive and involves a long process as opposed to other remediation techniques ie waste material removal and cover systems including barriers.

This area is densely urbanised and the space required to carry out in situ bioremediation is often not available. Also, the additional time needed, together with uncertain results, can count against its choice and add to costs if the job is funded by bank loans.

Expertise of the consultant/contractor - must demonstrate a good understanding of the issues and applicability

I think bioremediation is definitely a remediation technique which should be used more

It makes sense to utilise bioremedial technologies, economically and environmentally.

Developers normally think about contamination too late. They want a quick fix. With the credit crunch we are hoping that developers may take the drop in market to carry out longer, but more cost-effective, bio-remediation work on site.

I follow the recommendations of consultants.

Preferred remediation technique where appropriate, rather than treatment off site.

More towards 10% level however some recent sites for TPH or PAH included a gasworks and station/scrap yard under redevelopment. Other sites have included a former creosote works (1990s), and some hotspot work at other sites. Seems quite a few sites for TPH bioremediation and generally suitable.

Providing the method is acceptable to the EA and can demonstrate achievable improvements then I am happy to accept its use.

would like to see it happen

I often find that bio-remediation offers a high standard than other methods and strongly encourage it's use.

Time and space constraints (especially on development sites) mean although sometimes technically viable practical reasons mean its not used

If it is carried out properly it will reduce the need for dig and dump. but there are normally restrictions due to size of site and timescales that the developer will consider. The only one in this area was using windrows to deal with some hydrocarbon contamination (oil tanks) and this also reduced PAH levels as well.

Is only really used to clean up hydrocarbon contamination. Has in my experience left a residual problem with PAH's

In my experience, bioremediation isn't typically used with sites showing high levels of PAHs, since substances such as BaP respond particularly poorly to biodegradation. Though i understand success has been had with White Rot Fungus.....

To add to above comments generally bioremediation is not used. Has been used extensively on (*Name of the site*) site and on occasions to a limited degree on other sites (usually just addition of nutrients to promote bacterial growth).

Remediation options for any site must be demonstrated to be suitable on a site specific basis to an agreed validation level.

would love to see it

Bioremediation is not favoured by developers due to time constraints. Also, generally not applicable to higher mol weight polycyclics so not appropriate in some cases either.

Bioremediation has been used on two development control sites to my knowledge in (*Name of the Local Authority*) - mainly to clean up soils which were contaminated by hydrocarbon spills of leaks from old

underground fuel tanks. Such remediation is encouraged where ever it could be effective. Unfortunately bioremediation seems not to be reliable enough to clean up soils to a safe concentration needed for an end use as domestic gardens.

If bioremediation was being proposed then we would be looking for evidence to suggest that the technology would be appropriate on a particular site and capable of achieving the required standard.

Soil has been aerated to increase degradation rates in order to reduce its waste category and hence save money.

I would not recommend bioremediation as the sites we have where it has been used it has not worked

It would be necessary to provide sufficient information in the form of appropriate trials (specific to the site conditions) - to be able to show that the method would be successful. This is likely to result in developers choosing other options that can be achieved in a shorter time.

Important to protect public health and to guard against nuisance (noise, odour and dust). Toxic volatiles released into the air near to residential / schools can be problematic to deal with in terms of PR. Air quality standards that are protective of health are sometimes difficult to find / derive. The remediation methodology therefore needs to be carefully considered before approval. The contractors must demonstrate that they can protect human health BEFORE they start on site.

Question 5: Please indicate to what extent you agree with each of the following statements relating to contaminated land.

Bioavailability tests used for SI when there was exceedences of SGVs

I think this is an area requiring much more research. I am firmly of the opinion that our perception of risk is far greater than the actual or true risk posed in many contamination assessments. It is recognised that non consideration of what is and what is not both bioavailable and accessible can lead to gross over estimation. This can result in a number of negative impacts both financially and in terms of human health risk assessment. PAH's BaP and Arsenic are the immediate areas most often quoted and referenced in the debate.

For the final question it would depend on the contaminant of concern

We need clear guidance on how and when to use bioaccessibility data.

In regard to the last statement 'information' the Environment Agency or Defra's acceptance of bioavailability / bioaccessibility is key to both consultants and Local Authorities using or relying on such approaches in making decisions.

Work undertaken by BGS demonstrates the suitability of bioaccessibility testing for contaminated land management (at least for metals), despite the 'sitting on the fence' approach of the EA to this method

It would seem to me that PAH bioavailability data would be one small aspect of an overall risk management process with regards to a contaminated site's assessment and remediation. The costs financially and in project time for such a small aspect of the risk management process would probably make it unviable. Far greater importance should be made of the SPR linkages (as most risk assessment work does) and risks to proposed site end users.

We have used bioavailability data on a site which we are looking at determining. Our site involved B(a)P, Pb and As.

There is obviously a great deal of concern about the potential for using such tests in the field, particularly with respect to the differences determined by the pollutant under consideration and the lack of sufficient guidelines regarding its applicability

After taking advice from the EA this council does not currently accept bioaccessibility testing. However, I can see the advantages of its use and provided that there is strong, scientifically robust information which is reproducible and suitable for the site, we may accept it in the future.

Each site is considered on its merits and all investigative measures would be considered.

Additional information on bioavailability is inevitability of interest and use.

At a glance total contaminant concentration is frequently used to assess sites but each site should be assessed in more detail and bioavailability/bioaccessibility data would be useful. Most of the sites remediated through planning do not even consider bioavailability/bioaccessibility data.

Although the bioavailability/bioaccessibility is an useful parameter to assess contaminated land, its legitimacy of using to determine the land is somewhat ambiguous.

I think bioaccessibility is useful but there is no certainty of its use in this field and lack of guidance and information to either support or disagree with using bioaccessibility. If we use it there is no government body to back us up and support us and if we don't use it, what else do we use? There appears to be no alternatives put forward

Bioaccessibility/Bioavailability is useful data when used carefully, there is however a general lack of understanding surrounding this area in part due to a lack of practical guidance, how to sample, how many how to incorporate into risk assessment etc.

Generally PBETs should be used with caution/not used in line with EA/HPA guidance. If the last question refers to risk modelling then usually the attenuation of contaminants as a result of biodegradation would require direct evidence that these processes were occurring. In terms of use of PBETs, EA/HPA guidance should be followed (i.e. that PBETs, etc has limited application at present).

More guidance from DEFRA/EA is needed to make local authorities more confident in accepting bioaccessibility as a risk assessment tool but it could be very valuable.

Consider that more research is needed to produce more consistent results in relation to how bioaccessible or bioavailable contaminants are - information on bioaccessibility and bioavailability can aid decision making that produces more sustainable solutions

We currently use bioaccessibility testing for heavy metals - lead and arsenic, in our DQRAs carried out

in house. I consider that such testing is an essential element of risk assessment on sites. I am not aware of any bioaccessibility testing for BaP or other PAHs. I have heard that there are many difficulties in developing a reliable test and doubts about how the test would actually reflect human health risk.

In this district Pb and As are naturally occurring at levels above the SGVs without any known impact. As the bioavailability/bioaccessibility of pollutants from these sources is likely to be consistent over large areas bioavailability is an approach we are going to pursue despite it being out of favour (see also the work at *(Name of the site)*). B(a)P is also widely occurring and causes consternation to developers. HPA advice on non-threshold pollutants would be more useful than an on going debate about the bioavailability/acc of B(a)P.

In relation to point 2 i have chosen 3 because i neither agree nor disagree with this statement as both may be important in decision making upon a case.

At this time, as a contaminated land officer (ie not specialist ecotoxicologist/microbiologist etc), I do not have sufficient specialist knowledge o determine whether or not a bioremediation scheme would be effective

Not only do we need some more information, we need acceptance by the EA / DEFRA for example.

Question 6: Which, if any, of the following factors hamper the application of bioavailability/bioaccessibility data in your area?

Changeable way in which bioavailability/bioaccessibility is viewed by EA.

Uncertainty is with regard to bioaccessibility/bioavailability of PAHs and not specific metals

I have not received a single report that has used any bioavailability data as part of the risk assessment of a site investigation. To me, it seems over-rated as the technology to analyse for bioavailability is too crude.

Lack of guidance / training in this subject in order to critically assess data submitted

We have used it but as it is an emerging field of science (in terms of regulation) we have to be careful when applying the data to risk assessments. There is also the issue of what method of assessment, for example with Lead, what pH do you use to model the stomach, we ended up using a time-weighted average value.

I have used and accepted bioaccessibility data on sites, however the range of substances for which there is a reasonable body of evidence at present is limited.

I understand that there is reluctance to accept bioaccessibility/availability by Defra.

We use for arsenic down in (*Name of the Local Authority*)

We only use it for arsenic

If there is no full endorsement of the methodology it is hard decision for local authorities particularly on sensitive residential developments.

I think also lack of expertise in order to interpret results and extrapolating that information to determine risk.

We have no problems with data in this area.

Although uncertainty is a major issue (except for some contaminants), it still doesn't put me off using bioavailability/bioaccessibility as it seems to with the EA

I take the view that where there is naturally occurring arsenic in the soil using bioavailability is appropriate

We use bioavailability / bioaccessibility data regularly even with the uncertainty and lack of guidance but with awareness of these issues.

Legality of using this kind of data.

Any testing that I have encountered has been carried out by consultants working for developers. We have not done any for Part IIA purposes.

This type of data does place a strain on internal resources when submitted to support planning applications, due to the complexity of the information and the lack of capability of individuals who submit the risk assessment.

Most consultants aren't aware of current situation regarding PBETs.

Despite the above, we do accept bioaccessibility testing for arsenic given the naturally elevated arsenic found in our area associated with the geological coal deposits

We use bioaccessibility testing in our own work. I have not had such data submitted to me as part of risk assessments for development control sites. I am not sure that I would except such reports until there is some official guidance published by the Environment Agency/Defra etc

Its generally not a technique that developers select. Even for bigger voluntary remediation projects e.g. gas works, the preferred technique has been dig and dump. May be we will see more of a shift towards these less 'traditional' methods as a result of cost implications.

My [probably out of date understanding] is that bioavailability/bioaccessibility has lost favour with most regulators. Consultants have quoted figures derived from other sites and this has led to a lack of credibility. In the past bioavailability/bioaccessibility tests were used for inorganics and so the use of bioavailability/bioaccessibility of organics is an area of interest. As organics normally occur as a cocktail, either due to a spill of mixed chemicals or due to degradation giving rise to a mixture of chemicals of greatly differing toxicities, I would be interested how a test for bioavailability/bioaccessibility can be applied to such

It is unlikely that guidance issued would be statutory guidance, but i would agree that detailed research

and guidance is lacking in this subject area. In addition there is a lack of guidance and research of the subject of risks to human health from all hydrocarbons which needs to be addressed as a matter of urgency considering the frequency they are encountered on sites.

Question 7: Do you make any distinction between the terms bioavailability and bioaccessibility?

Bioaccessibility is the process of conversion of chemical of concern in a soluble state. Usually within the body-digestive system. Bioavailability refers to a percentage of the total available dose.

Bioaccessibility is the amount of contaminant that becomes available in solution in the gut.
Bioavailability is the amount of contaminant that enters the blood stream.

bioavailability and bioaccessibility have very different meanings but are often used interchangeably

What is accessible and what is available are two different things. Accessible is able to be taken, available is that it is there but may not be all accessible.

bioaccessible - that which becomes available to the stomach/gastrointestinal tract from the soil
bioavailable - that fraction which can cross the gastro intest wall into the blood stream

Bioavailability seem to be the most appropriate term or used more often. Not familiar with bioaccessibility but they mean the same thing.

Bioavailability is the intake of a contaminant that is uptaken into the bloodstream and bioaccessibility is the fraction of intake released in the ingestional system.

Bioavailability is determined based on testing on humans/animals and bioaccessibility is determined based on testing that tries to replicate tests on humans/animals without actually using them directly

We use the terms as in Bioavailability: what the organism can physically access from the soil.
Bioaccessibility: What the organism can uptake from the ingested material

Bio accessibility: The potential for a substance to interact with (and be absorbed by) an organism
Bio availability: The degree to which or rate at which a drug or other substance is absorbed or becomes available at the site of physiological activity

Bioaccessibility = the amount of contaminant released from the soil during digestion etc and so is accessible to the body, bioavailable is the amount absorbed by the body.

Bioaccessibility - fraction of soil released from the soil during digestion
Bioavailibility - fraction of contaminant taken into the body

bioavailability is the fraction absorbed by the body. bioaccessibility is the fraction available for absorbtion

I do not use the terms at all.

Differentiated using the terminology used in the old CLR9 document: Bioavailability is the fraction of the chemical that can be absorbed by the body through the gastrointestinal system, the pulmonary system and the skin. the intake of contaminants that are bound to soil and those which occur as a vapour or are released during processes like digestion into solution (the so-called bioaccessible fraction)

I have received training and where necessary can revert to my course notes for a refresher

Bioavailability: The fraction of the chemical that can be absorbed by the body through the gastrointestinal system, the pulmonary system and the skin. Bioaccessibility: The fraction of a substance that is released from soil during processes like digestion into solution.

Bioavailability - present to bioreceptors
Bioaccessibility - available to relevant bioreceptors

Bioavailability is the concentration of a contaminant available to a biological system from the soil.
Bioaccessibility is the concentration of a contaminant that is available from the soil to be absorbed into a human (in the case of contam. land risk assessment).

Bioavailability is defined as the extent to which a chemical can be absorbed by a living organism or the fraction of the chemical that can be absorbed by the body through the gastrointestinal system, the pulmonary system and the skin. Bioaccessibility is the fraction of a substance that is released from the soil during processes like digestion into solution (the so called bioaccessible fraction), making it available for absorption.

bioavailability - what is available for plants uptake. bioaccessibility- what can be accessible to plants.

In HHRA terms I would use as follows: Bioavailability = fraction of a contaminant that can enter the blood stream (usually basis of a health criteria value e.g oral bioavail of As)
Bioaccessibility = fraction of a contaminant that is soluble/absorbed in the gastrointestinal environment

Bioavailable : ratio of intake to uptake. Bioaccessibility usually a measure of a part of the absorptive system e.g digestive tract.

I would say bioaccessibility is what the system ingests or comes into contact with and that bioavailability is the proportion of the ingested/absorbed, etc. portion of the substance that is available to the system.

'bioaccessibility' refers to the amount of a specific chemical contaminant that is released from soil when it is exposed to experimental conditions that mimic the conditions in the human gut. Bioavailability refers to the difference between the amount of a substance (chemical) to which a person is exposed and the actual dose of the substance the body receives.

Bioaccessibility - lab derived value. Bioavailability - actual amount available and taken up by the body

We understand the difference in terms.

Bioavailability refers to difference between intake and uptake (ie. the fraction that can be absorbed through GI tract, lungs, skin - calculated via in vivo studies). Bioaccessibility is the fraction which would be soluble in the GI tract and therefore available for absorption (in vitro studies simulate human GI tract). Neither is foolproof as need to extrapolate from animal or in vitro models to human. Models generally overpredict bioaccessibility.

Bioavailability testing gives the fraction of a contaminant which is absorbed into the body fluids of an organism, whereas bioaccessibility gives that fraction which is available to be absorbed i.e. the fraction which would go into solution in the stomach/intestines. Normally bioaccessibility should be higher than bioavailability. Test results such as PBET and SBET give bioaccessibility data, bioavailability can only be determined from animal in vivo studies - as far as I know.

They sound as though they mean pretty much the same thing but to be honest I really don't know

Whilst bioavailability and bioaccessibility are quite distinct, the aims of the approach are similar and so I do tend to use these terms interchangeably.

Bioavailability is that available in the soil for intake, bioaccessibility is that available for uptake, once mobilised by the digestion process

Bioaccessibility is the amount of contaminant available to the body from the soil and bioavailability is the amount that is available for the body to uptake.

I am aware of the difference between the two. Pbet tests are usually submitted and used predominantly in the sniffer model to provide a revised SSAC. This is used only as an indication of what concentration may be acceptable as the EA have not endorsed the use of bioaccessible/ bioavailability testing for any contaminant.

Bioaccessibility = amount that is able to be extracted in the gut and bioavailability is that able to be absorbed into the blood stream from the gut. I think.